

Polynomial Long Division

A) Long Division (sometimes known as Synthetic Division):

Work out $654 \div 9$ by long division:

$$\begin{array}{r} 72 \\ 9 \overline{)654} \\ \underline{63} \\ 24 \\ \underline{18} \\ 6 \end{array}$$

Therefore $654 \div 9 = 72$ remainder 6, or $72 \frac{6}{9}$.

B) Polynomial Long Division

Example 1: Divide $x^2 - 3x + 4$ by $x + 9$.

1. Start by setting up the division like you would for a synthetic division:

$$x + 9 \overline{)x^2 - 3x + 4}$$

2. Divide the first term of the dividend (which is the x^2 in $x^2 - 3x + 4$) by the first term of the divisor (which is the x in the $x + 9$). The answer to this division problem is your quotient, which will be written above the line in your division bracket.

$$\begin{array}{r} x \\ x + 9 \overline{)x^2 - 3x + 4} \end{array}$$

3. Write the product of the quotient and the divisor below the dividend, in order to subtract: $\{ x \cdot (x + 9) = x^2 + 9x \}$

$$\begin{array}{r} x \\ x + 9 \overline{)x^2 - 3x + 4} \\ x^2 + 9x \end{array}$$

4. Work out the remainder and then bring down the next term: $\{ (x^2 - 3x) - (x^2 + 9x) = -12x \}$

$$\begin{array}{r} x \\ x + 9 \overline{)x^2 - 3x + 4} \\ \underline{x^2 + 9x} \\ -12x + 4 \end{array}$$

4. Repeat until every term in the dividend has been divided by the divisor:

$\{ -12x \div x = -12, \text{ so } -12 \text{ is the next term in your quotient, and the product of } -12 \text{ and } x + 9 \text{ is } -12x - 108 \}$

$$\begin{array}{r} x-12 \\ x+9 \overline{)x^2-3x+4} \\ \underline{x^2+9x} \\ -12x+4 \\ \underline{-12x-108} \end{array}$$

5. Work out the remainder: $\{ (-12x + 4) - (-12x - 108) = 112 \}$

$$\begin{array}{r} x-12 \\ x+9 \overline{)x^2-3x+4} \\ \underline{x^2+9x} \\ -12x+4 \\ \underline{-12x-108} \\ 112 \end{array}$$

Therefore $(x^2 - 3x + 4) \div (x + 9)$ or $\frac{x^2-3x+4}{x+9}$

$= x - 12$ and remainder 112

$= x - 12 + \frac{112}{x+9}$

Example 2: Divide $x^3 - 2x^2 + 6x + 3$ by $x - 2$.

$$\begin{array}{r} x^2 \\ x-2 \overline{)x^3-2x^2+6x+3} \\ \underline{x^3-2x^2} \\ 0+6x+3 \\ \underline{6x-12} \\ 15 \end{array}$$

Delta: Exercise 26.1 page 237 Q1-10.